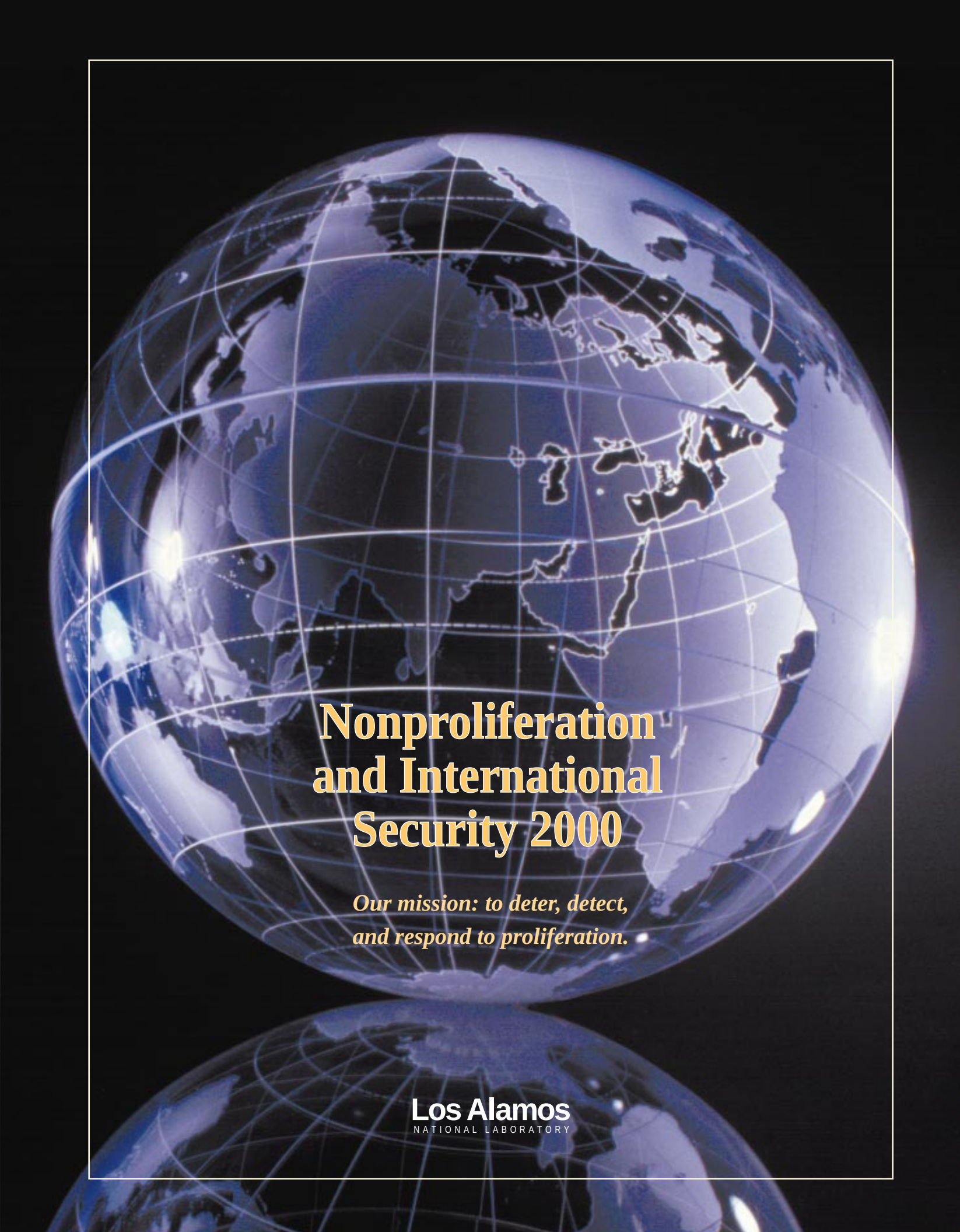

# Nonproliferation and International Security 2000

*Our mission: to deter, detect, and respond to proliferation.*

Los Alamos
NATIONAL LABORATORY

# Table *of* Contents

# Nonproliferation *and* International Security

The proliferation of weapons of mass destruction (nuclear, biological, and chemical) is widely recognized today as the most serious threat to the security of the United States since the end of the Cold War.

In this ominous context, proliferation also includes the sobering prospect that terrorists may acquire and use these weapons against our citizens. The Nonproliferation and International Security (NIS) Division was established at Los Alamos National Laboratory in 1993 to respond to this growing threat. Our mission—*to deter, detect, and respond to proliferation*—is a major component of the Laboratory's core mission *to reduce the global nuclear danger.*

Accomplishing this mission requires the dedicated efforts and talents of some of the best and brightest scientists and engineers working in multidisciplinary teams on highly complex problems. Many NIS employees have advanced degrees in atmospheric and space sciences, astrophysics, nuclear physics, computer sciences, biology, chemistry, and engineering of all types, and this is only a partial list of the skills we need to do the job. Because our work is science-based, we work with universities and other research laboratories around the world. Because there is little margin for error in our work, we work in partnership with some of the very best high-technology companies. Because of the international aspects of the problem, we collaborate with institutes and scientists around the world to prevent the migration of nuclear materials and technologies into illicit proliferation programs. Most of all, we derive the satisfaction that comes from accepting the challenge and producing unique products that make a difference to the safety and security of everyone. The men and women of NIS are proud to play a major role in reducing the global danger.

The relevance and quality of our efforts is validated annually by a panel of outside experts from government, academia, and industry. The NIS Division Review Committee (NISDRC) awarded NIS Division the highest possible ranking of "Outstanding" for the quality and relevance of its science and technology programs for the past three years.

NIS Division is world-class not only in our science and technology but also in our conduct of operations. The Division was awarded the 1999 Business Management Award for our "outstanding performance in the combined management of finance, procurement, and property," and our electrical safety program has been recognized as best in class in the Laboratory.

I hope you will take time to browse through this brochure and get to know us better. If you have questions or comments, I would like to hear from you.

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## *Best in class in science and technology and in operations . . .*

*Bill Priedhorsky, NIS Chief Scientist; John Dassoulas, Chair of the NIS Division Review Committee (NISDRC); and Cliff Giles, NIS Deputy Director for Science and Technology, discuss plans for the January 2000 external assessment of the science and technology in NIS Division. The NISDRC awarded NIS Division the highest possible rating of "Outstanding" after their reviews in 1997, 1998, and 1999.*

*Members of the 2000 NISDRC were Paul DeLuca, Don Kerr, Jack Vorona, Patricia Reiff, Dick Kerr, France Cordova, John Schott, Darleana Hoffman, Don Lamb, John Dassoulas, and Frank von Hipple.*

*Allan Johnston, Director of Business Operations Division (BUS), presents the 1999 Business Management Award to NIS Division Director Terry Hawkins. This award is given "in recognition of outstanding performance in the combined management of finance, procurement, and property." Also shown are Evelyn Mullen, NIS Deputy Director for Operations, and Kurt Tiefa, Business Team Leader for NIS Division.*

### NIS Role within the Laboratory Mission

Los Alamos National Laboratory's historic work on the Manhattan Project prevented the loss of countless lives at the end of World War II. During the Cold War, the Laboratory's work facilitated nuclear deterrence and 50 years of peaceful coexistence. The end of the Cold War, the collapse of the Soviet Union, and the changing world political structure mandated changes in the Laboratory's mission. Today's mission—"enhancing global security"—is no less compelling.

Currently, the principal security problem for the United States is the rise of so-called "rogue" terrorist states. These are countries who are unhappy with the geopolitical status quo and who are determined to overturn it, using threats and force as necessary. Many rogue states and their affiliated terrorist groups see the United States as the principal architect and enforcer of the stable post-Cold War world order that they despise. These groups may not only challenge the United States and its allies, but may seek to attack vulnerable points inside US borders rather than challenge US military forces directly. These new threats are made more worrisome by the growing availability of advanced military technology, including weapons of mass destruction.

NIS Division is leading the way at Los Alamos to meet these new world order challenges. National efforts to address this new set of security requirements are often referred to as "threat reduction." Under the Threat Reduction (TR) Directorate, NIS Division coordinates many programs and is expanding the Laboratory's international threat reduction role.

NIS is leading the way in efforts to secure weapons-usable nuclear materials, especially in the states of the former Soviet Union. NIS is also leading intralaboratory working groups on the Comprehensive Test Ban and START III arms control initiatives. And by working closely with the Department of Defense (DoD) Programs Office, NIS Division leads or supports other important national initiatives such as countering nuclear, biological, and chemical weapons and defeating hard and deeply buried targets.

## NIS Vision

Our vision is a world with reduced nuclear dangers, as well as other threats to US and international security, through excellence in science and technology.

## NIS Mission

Our mission is to develop and apply preeminent science and technology capabilities to deter, detect, and respond to proliferation of weapons of mass destruction and to ensure US and international security.

## NIS Objectives

We pursue five strategic objectives to accomplish our mission and realize our vision:

- Deter threats to domestic and international security.
- Detect and assess threats to domestic and international security.
- Respond to domestic and international security threats.
- Excel in science and technology.
- Ensure an environment that nurtures, supports, and rewards people working to accomplish our challenging mission.

## NIS Organization

NIS is both a program and line organization. Five Program Managers support the Associate Laboratory Director for Threat Reduction and the NIS Director in managing the NIS Program. Typically, about 75% of NIS program activities occur in NIS Division and the remainder throughout the rest of the Laboratory. The NIS line organization includes nine technical groups and two facility management units. The nine groups typically obtain about 75% of their funding from NIS programs, and the remainder from supporting technical activities of other programs and divisions.

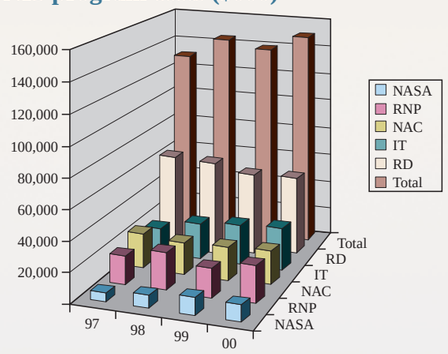
## Program and Research Focus Areas

NIS has Laboratory wide responsibility for five principal focus areas: nonproliferation and arms control (NIS/NAC); Russian nonproliferation programs (NIS/RNP); nonproliferation research and development (NIS/RD); international technology (NIS/IT); and NASA research programs. The latter program is administered by the Center for Space Sciences and Exploration (CSSE). The first four areas represent the essence of the NIS national security programmatic mission. Major NASA activities are synergistic with our national security mission. Each program area is described in this book.

## Budget

The total NIS program budget in fiscal year 1999 was $139 million. The data shown in the bar graph include both operating and capital budgets but not construction funds. Changes within the individual major programs reflect changes in funding agency priorities.

### NIS program costs ($000)

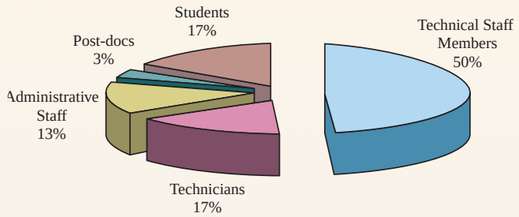



## Workforce

Meeting the NIS mission objectives demands a multifaceted workforce that covers a spectrum of skills and capabilities. The total workforce consists of about 700 employees. Slightly over two-thirds of the NIS workforce are University of California (UC) employees. About a fifth are postdoctoral appointees and students who contribute fresh perspectives and the latest in formal skills. The remainder includes limited-term appointees, contract employees, Laboratory associates and affiliates, guest scientists, and visiting staff members.

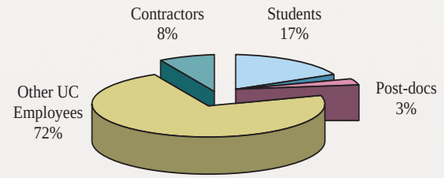
Technical staff members (TSMs) comprise the largest share of NIS UC employees. Eight current NIS TSMs and five NIS Laboratory Associates have achieved the rank of Laboratory Fellow, a distinction that recognizes exceptional

### NIS staff profile (October 1999)

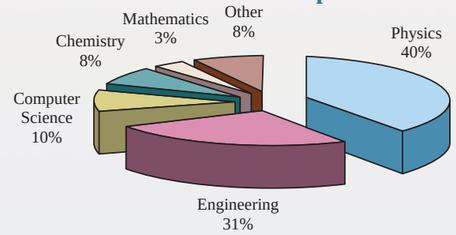



contributions to Laboratory programs and scientific excellence. A significant number have been recognized by professional associations, or serve in association leadership positions. Physics and engineering are the predominant technical disciplines among NIS staff, though other fields, such as those related to computational capabilities, are becoming increasingly important.

### NIS employment distribution (October 1999)




### NIS technical staff profile




## Unique NIS Contributions to National Security

The scope of the NIS mission and the breadth of its capabilities present division members with opportunities for unusual contributions and achievements. A sampling of recent assignments includes the following: leading the intralaboratory working group that deals with nuclear material control programs in the former Soviet Union; serving on the staff of federal agencies, including the Department of Energy (DOE), DoD, National Security Agency (NSA), and Central Intelligence Agency (CIA); supporting the Comprehensive Test Ban Treaty negotiations; serving as a NASA astronaut; serving in leadership positions for the Institute of Nuclear Materials Management; and serving on boards and teams for various federal agencies.

## Commitment to the Future

Tomorrow's technological challenges in ensuring our national security will require ever-increasing scientific and technical talent, creativity, and ingenuity. NIS believes in the advantages of a diverse workforce and aggressively pursues recruitment of the best and the brightest recent graduates, postdoctoral fellows and associates, and graduate and undergraduate students. In fiscal year 1999, we hired 32 new TSMs, including several women and minorities, with 12 of the new hires at the entry level. We employed 23 post-doctoral staff, including one Oppenheimer Fellow. Our student programs included about 40 graduate research associates and 80 undergraduate employees. We awarded more than $44,000 in college scholarships to 55 undergraduate and graduate students throughout New Mexico and the nation.

## Nonproliferation and International Security Center

This new 164,000 square foot laboratory office complex will consolidate most NIS program and division resources and functions at the Technical Area 3 (TA-3) site with occupancy of the building scheduled for fiscal year 2003. The multistory facility (full basement plus four stories above ground) will house approximately 465 people in spaces for technical and administrative offices, light laboratories, light manufacturing, special security, and support activities. The laboratories will be for physics, electronics, optics, instrumentation development, computing, intelligence, and other uses. Significant features include nuclear instrumentation development and training laboratories in the basement; a high-bay laboratory with adjacent machine shop on the first floor; technical and administrative work spaces on the first, second, third, and fourth floors; and a greatly expanded Sensitive, Compartmented-Information Facility (SCIF) on the third and fourth floors.

# Nonproliferation *and* Arms Control Programs


**NIS–NAC**

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The Nonproliferation and Arms Control Programs' office and activities with technical groups such as NIS-5, -6, -7, and -8, supports a variety of programs designed to minimize the risk of nuclear weapons proliferation.

Nuclear weapons nonproliferation and arms control is best implemented by worldwide control of fissile materials. To that end NIS-NAC supports programs designed to permit the disposition of plutonium and other materials from nuclear weapons without compromising classified information. This work includes the following:

- A trilateral program with Russia and the International Atomic Energy Agency (IAEA) to develop procedures for secure disposition of material removed from the weapons program.
- Bilateral programs with Russia to explore methods for verifying the dismantlement of nuclear warheads to reduce the numbers of weapons on both sides.
- Other programs with Russia to develop procedures to implement and monitor the cessation of Russian weapons-grade plutonium production.

Through the IAEA, Los Alamos provides technology for an evolving Integrated Safeguards program that will improve the IAEA's ability to locate covert facilities for producing fissile material. This enhanced safeguards effort builds on existing IAEA safeguards for declared facilities; Los Alamos has provided the principal technical support for IAEA safeguards efforts for over 30 years. Recent declassifications will make it possible to extend IAEA monitoring programs to neptunium and americium as well as plutonium and uranium. This work in nuclear materials control benefits from over a half-century of research at Los Alamos on Domestic Safeguards and Security issues, as well as the International Safeguards work that began in 1966. Today many of the same security capabilities find application in programs to update and improve computer security and related infrastructure protection measures.

Explicit cooperative activities with other countries are especially effective measures for materials control. Especially noteworthy in this regard are the projects in Materials Protection, Control, and Accounting in Russia, which are programmatically housed in NIS-RNP. In a similar vein, NIS technical expertise supports programs to monitor the downblending of highly enriched uranium in Russia (being sold to the US as low-enriched uranium for commercial use) and to protect spent reactor fuel in Kazakhstan.

*In June 1999, Sara Scott was selected as Program Manager for NAC programs.*

Materials control efforts may soon be formalized in a worldwide Fissile Materials Control Treaty, where NIS-NAC will work to provide technical expertise to DOE negotiators. Such efforts benefit from years of technical support in the successful negotiation of a Comprehensive Test Ban Treaty (now awaiting final ratification and entry into force) as well as earlier support to a variety of international treaties and agreements.

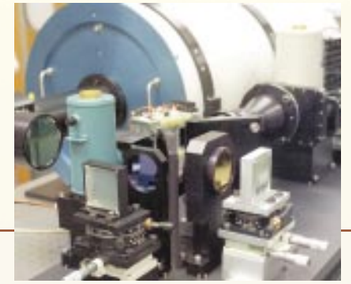
Beyond the control of fissile materials, the United States combats proliferation through an array of international agreements and cooperative programs that control technical exports. NIS scientists work with officials from several government agencies to provide technical judgment on the applicability of such exports to weapons use.

The Nonproliferation and Arms Control Programs office and the technical groups anticipate continued growth in government efforts to counter nuclear proliferation, with parallel growth in the essential technical support that Los Alamos provides.

*Duncan MacArthur (NIS-6), Diana Langner (NIS-5), and Nancy Jo Nicholas (NIS-6) demonstrate the 3-ring Neutron Multiplicity Counter used in many materials monitoring applications.*

*Rena Whiteson and John Puckett (NIS-7) meet with visitors at a trilateral demonstration of materials monitoring technology, TA-18.*

# Research *and* Development Program



*Spatial Heterodyne Spectrometer (SHS) in calibration.*


**NIS–RD**

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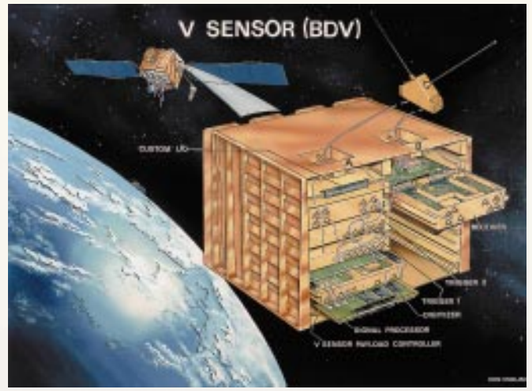
NIS-RD is a leader in conducting research and development in support of the nation's nonproliferation program. Fostering the growth of the research and development program in support of proliferation detection is a NIS strategic initiative. This research and development effort includes identifying and cataloging signatures for proliferation activities and developing sensors capable of detecting and characterizing these signatures. Our instrumentation development envisions space-, air-, sea-, and land-based deployment scenarios. Current research and development projects are investigating a broad range of potentially useful techniques that use a large part of the electromagnetic spectrum, from vhf through gamma rays, in both active and passive detection methodologies.

Members of the defense community, including DOE, DoD, the Department of Justice, and the national intelligence community, apply these technologies in both overt and covert configurations and in local, regional, and worldwide deployments.

NIS-RD manages nonproliferation and treaty verification research and development at Los Alamos for the DOE's Office of Nonproliferation Research and Engineering (NN-20), which currently sponsors the largest US research and development program supporting national nonproliferation and arms control policy objectives. NIS-RD reflects the DOE programmatic emphasis, which includes the following specific research and development areas:

- Proliferation Deterrence: developing capabilities primarily targeted at monitoring nuclear materials and facilities, and ultrasensitive detection of effluents.
- Chemical and Biological Nonproliferation: improving emergency response to the transnational use of chemical and biological weapons.
- Nuclear Test Detection: providing capabilities to verify compliance with nuclear testing treaties.
- Proliferation Detection: providing advanced systems and technologies for remote and *in situ* detection of processes indicative of the proliferation of weapons of mass destruction.

*RANGER portable monitoring unit in use at the Los Alamos plutonium facility.*




*Advanced ultrasensitive electromagnetic pulse detection system under development.*

Among the technologies we envision for deployment in the proliferation detection and prevention arsenal are effective remote-sensing and monitoring devices, low-cost ubiquitous sensor platforms and sensors, and high-speed data processing and information networks.

NIS-RD is attempting to develop monitoring systems capable of detecting all potentially significant nuclear tests, even those at very low yields. Satellite-based systems will continue to be the backbone of the monitoring system for tests in the atmosphere and in space. Follow-on systems to the existing global positioning systems and DSP satellite systems are being developed to achieve improved sensitivity at lower weight and power levels by taking advantage of modern sensor technology. Through such programs as FORTÉ, a satellite-based experimental test bed for electromagnetic pulse detection, the research and development effort is achieved through the use of small, highly efficient and inexpensive satellite systems. In the area of underground testing, the emphasis for monitoring will be on the detection of small, evasively conducted tests. These types of tests must be detected by worldwide seismic, and/or hydro-acoustic systems, which are presently undergoing significant capability upgrades in preparation for monitoring the Comprehensive Test Ban Treaty. NIS will continue to play a major role in the planned evolution of all of these systems as they are brought up to required capabilities to satisfy this new monitoring regime.

*An "adaptive computing" circuit board, incorporating field programmable gate arrays. For many applications, this technology has significant advantages over traditional microprocessor-based systems.*

# International Technology Program

**NIS–IT**

**Program Manager:** Anthony E. Burris
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The growing worldwide inventories of special nuclear materials, the technical simplicity involved in producing biological and chemical agents, the increased access to missile technology for delivery systems, and increases in regional strife have all contributed to the problem of proliferation of weapons of mass destruction. The problem is further complicated by the specter of subnational terrorists employing these weapons or of organized international criminals trafficking nuclear materials and nuclear weapons components. Information-based attacks on critical national infrastructures are also of increasing concern. Moreover, rapid advances on all technology fronts have increased the likelihood of a "technological surprise." To guard against such happenings, Los Alamos National Laboratory, under the auspices of the DOE Office of Intelligence, continues to vigorously pursue a program that provides the US intelligence community with both technical assessments of these critical issues in support of national policy makers and creative technical solutions to otherwise "intractable" national security problems.

International Technology (NIS-IT) projects draw upon all-source intelligence data, the nuclear weapons expertise, and the multidisciplinary capabilities of the Laboratory, which all combined provide intelligence analysis for the intelligence community. NIS-IT provides technical estimates of foreign nuclear weapons, the related infrastructure, and the underlying science and technology base and capabilities. Los Alamos scientists provide assessments of nuclear weapons technology, materials production, nuclear proliferation potential, and dual-use technologies (i.e., technologies that are important to national defense but are beneficial in peaceful pursuits).

NIS-IT projects also tap into the interdisciplinary competencies at Los Alamos to develop specialized hardware and tailored application of extant capabilities. From explosives to pulsed power, from radio frequency detection to biotechnology, from information security to materials science, new technologies and new capabilities are being developed to help deter, detect, and respond to the threat of the proliferation of weapons of mass destruction. Through NIS-IT, the mission to deter, detect, and respond includes the following:

- Technical support to develop innovative options for mitigating new security threats, including those associated with the worldwide proliferation of advanced conventional weapons.
- Assessments of the relative impact of arms control treaties on foreign nuclear weapons programs.
- Advanced computational and analysis capabilities that provide rapid assessment of options for responding to evolving threats, including the capability to model the consequences of those response actions.
- A range of credible, high-confidence methods for locating, characterizing, and disabling weapons of mass destruction.
- Technologies that provide enhanced capabilities to commanders, special mission units, or law enforcement agencies.
- Access for the US law enforcement community to appropriate Los Alamos technical capabilities to counter criminal activities and terrorism with real-time access to Laboratory resources to support on-site reaction teams.
- Intelligence-based evaluations of nuclear smuggling and illicit trafficking of nuclear technologies and materials.

*NIS-IT provides the intelligence community with analysis and advanced technologies from across the Los Alamos National Laboratory.*

# Russian Nonproliferation Programs

## NIS–RNP

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The Russian Nonproliferation Programs (RNP) office provides Los Alamos with a focal point for its many interactions with the countries of the former Soviet Union. The RNP office primarily provides direct oversight for three of the Laboratory's most important international initiatives: the Materials Protection, Control, and Accounting Program; the Initiative for Proliferation Prevention; and the Nuclear Cities Initiative.

The RNP office also is a central organizing element to coordinate and facilitate communication among Los Alamos activities involving interactions with Russia. These include such activities as the Warhead Dismantlement and Fissile Material Transparency Program, the Plutonium Disposition Program, the Second Line of Defense, the Plutonium Registry Project, the Tri-Lateral Initiative, and support for the Mayak Transparency Negotiations.

The RNP office provides related information services in support of Los Alamos and specific programs, including the development and management of databases for tracking programmatic activities, contracts, reports, and budget information. RNP is a key Laboratory resource for hosting foreign visits, training courses, and many other interactions necessary for effective international cooperation.

### Materials Protection, Control, and Accounting

The DOE's nuclear Materials Protection, Control, and Accounting (MPC&A) Program is a partnership between the US, Russia, and other states of the former Soviet Union to improve nuclear materials security. This partnership has been built upon the confidence and trust that has developed between staff in the United States and in the former Soviet states. The MPC&A Program has instituted improved inventory systems and computer accounting methods, installed monitoring instruments, and upgraded physical protection at dozens of Russia's Ministry of Atomic Energy defense and civilian locations.

*Demonstration of "Passport" radiation signature system at Russia's Mayak nuclear materials storage facility*

### Initiative for Proliferation Prevention.

The Initiative for Proliferation Prevention (IPP) is a multilaboratory DOE program to identify and nurture the commercial development of promising technologies in Russia. IPP's emphasis is to promote commercial civilian application of capabilities that exist at institutes that have previously been involved in the defense sector. Ideas are screened and evaluated through collaborations between US scientists and Russian experts, and industrial partners are sought for those with the greatest potential.

### Nuclear Cities Initiative

The Nuclear Cities Initiative is a multilaboratory DOE program that focuses on providing civilian work to thousands of nuclear scientists and engineers who are located in Russia's ten closed "nuclear cities." Job creation, matchmaking with private enterprise, and developing contract research activities characterize the current efforts under the program, which began in FY99 with a $15 million dollar budget.

*LANL MPC&A staff train Russians on use of neutron measurement equipment.*

### Other Activities

Los Alamos also provides significant support for other US government initiatives with Russia. Two centers, the International Science and Technology Center in Moscow and the Science and Technology Center were established by multilateral agreements to fund civilian science and technology projects engaging scientists who have expertise in weapons of mass destruction and delivery systems. To date, the two science centers have funded over 1,000 projects for nearly $250 million dollars, involving nearly 30,000 highly qualified scientists and engineers. Another initiative involves support for US government efforts to provide secure storage for Russian plutonium recovered from the dismantlement of nuclear warheads.

### Resources

The RNP Information Resources Team provides timely and reliable services in support of Laboratory and individual programs doing cooperative projects with Russia. These services include the development and management of databases for tracking programmatic activities, contracts between the Laboratory and Russian institutes, programmatic reports, and related budget information. Over 320 users representing 200 organizations are connected to the database system with servers located throughout the United States.

### Highlight: MPC&A

The Los Alamos MPC&A staff work closely with scientists and engineers from other US DOE laboratories as well as with their counterparts from Russian facilities. Laboratory personnel have made major contributions to MPC&A projects at almost every Russian nuclear site. For example, Los Alamos personnel have led MPC&A work at Arzamas-16/Sarov (VNIIEF), one of the two Russian nuclear weapon design laboratories, which was one of the first former Soviet facilities to participate in this program. At Sarov, the best of Russian and American MPC&A technologies and methods have been combined in an extensive demonstration facility and implemented at several research and production facilities within VNIIEF. These technologies are now undergoing widespread implementation throughout the Russian nuclear weapons complex. Los Alamos staff have also made major contributions to MPC&A Program activities at Chelyabinsk-70/Snezhink (VNIITF), at the Obninsk Institute for Physics and Power Engineering, the Kurchatov Institute in Moscow, several large nuclear material operations sites including Tomsk-7/Seversk and Krasnoyarsk-26/Zheleznogorsk, and eight different facilities of the Russian Naval and Icebreaker fleets.

# Center *for* Space Science and Exploration


**NIS–CSSE**

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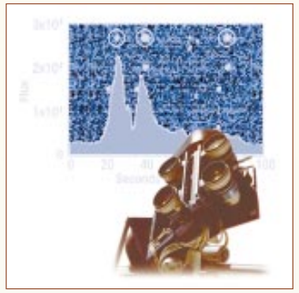
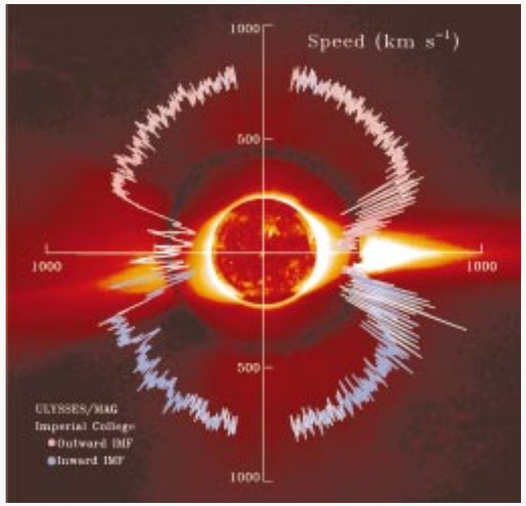
The Center for Space Science and Exploration (CSSE) serves as the focal point for civilian space efforts at Los Alamos National Laboratory. CSSE promotes scientific excellence in the space sciences and fosters interdisciplinary research between the space programs and scientific capabilities from across the Laboratory. This interaction serves to both enhance the scientific and technical underpinnings of the Laboratory's national security efforts and provide new resources for our nation's space program. CSSE relies heavily on the input from a steering committee composed of experts from a broad range of space-related areas representing Laboratory-wide capabilities. This steering committee serves to coordinate the various research efforts and keeps the interdisciplinary lines of communication open.

Today's space programs build on space science and technology work that dates back to the earliest days of space exploration with the Vela satellite program begun in the early 1960s. Now the Laboratory hosts over 60 NASA-sponsored (and several National Science Foundation-sponsored) space projects. NASA funding at Los Alamos has increased steadily over the past several years from ~$3 million a few years ago to a current level of over $10 million per year. CSSE fosters and supports these projects and the numerous proposals for new projects in several ways. First, CSSE is Los Alamos's NASA (and National Science Foundation/Space) program office. In addition, last year CSSE won a large multiyear program that directs the investment of internal Laboratory funding relating to space research. In addition to supporting ongoing areas of research such as space physics, astrophysics, and planetary science, this program is engaging new areas into the space efforts at Los Alamos, including astrobiology and exobiology, space nuclear power and propulsion, and advanced space materials. CSSE also provides information on upcoming opportunities, maintains outreach and inreach programs, and coordinates all the civilian space efforts at Los Alamos.

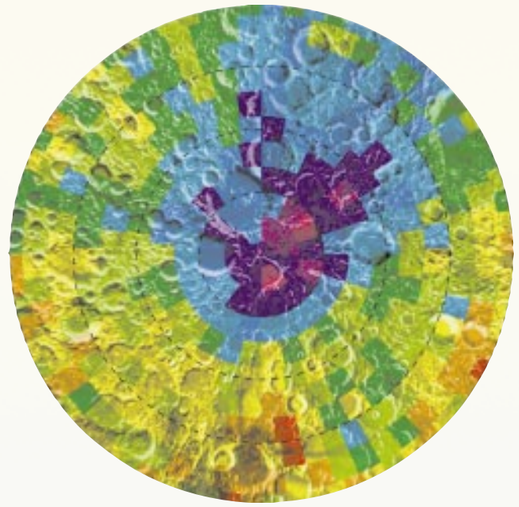


*Light from a gamma-ray burst. The ROTSE (Robotic Optical Transient Search Experiment) telescope pictured here recently detected, for the first time, images of visible light from a cosmic explosion (circled areas), which ocurred at the same time as spectacular gamma-ray data were being captured by orbiting satellites.*

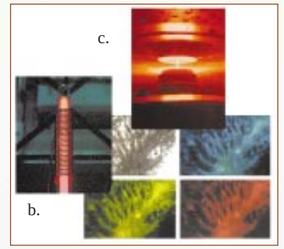
Recent science accomplishments in our programs include the first three-dimensional mapping of the solar wind using data from Ulysses spacecraft, observation of the first optical counterpart of a gamma ray-burst with Robotic Optical Transient Search Experiment (ROTSE), and discovery and quantification of water at the moon's poles from NASA's Lunar Prospector. Recent major instruments that have been developed for NASA missions include the ion beam and ion mass spectrometers in the Cassini plasma spectrometer instrument on its way to Saturn; the Advanced Composition Explorer solar wind electron and ion sensors; the Plasma Experiment for Planetary Exploration on New Millennium/Deep Space 1; and the neutron, gamma-ray, and alpha particle spectrometers on Lunar Prospector. Other instruments that we are presently developing for near-term NASA launches include the Medium Energy Neutral Atom instrument on the IMAGE spacecraft, the solar-wind ion and electron monitors and ion concentrator for the Genesis Discovery mission, the digital processing unit for the optical monitor on the X-ray Multi-Mirror Mission and the Two Wide-Angle Imaging Neutral-Atom Spectrometers mission.




*This figure shows measurements of the solar wind speed as a function of heliolatitude, which were taken by the Los Alamos instrument on the Ulysses spacecraft. Through these measurements, color coded here by magnetic polarity and overlaid on three concentric images of the Sun's corona, we discovered that the speed of the high-latitude solar wind is surprisingly constant.*



*Los Alamos scientists recently discovered and quantified water on the moon; this computer graphic shows the presence of hydrogen and, hence, water ice (purple) at the moon's north pole.*




*This collage of images shows (a) the fluorescent signatures of fossilized biological materials on Earth, which can help us look for similar structures elsewhere in our solar system; (b) a heat pipe under development for the heat-pipe power system (HPS), which is a fission power source intended to provide electricity for deep-space and manned missions; and (c) a beryllium-aluminum alloy plasma being converted to a powder. The high strength-to-weight ratio of such advanced materials makes them ideal candidates for space structures.*

# Space *and* Atmospheric Sciences

## NIS–1

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Deputy Group Leader: Morris B. Pongratz

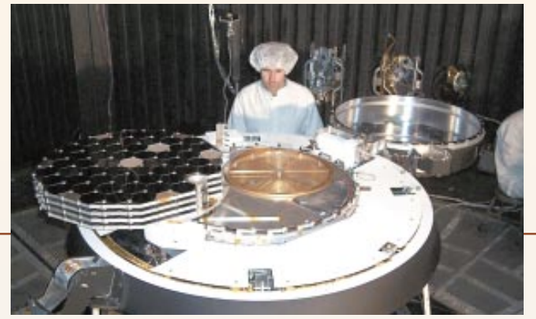
The Space and Atmospheric Sciences (NIS-1) group maintains a world-class expertise in space-based systems and related science and technology. Using satellite-born particle and radio-frequency detectors, NIS-1 monitors the atmosphere and near-earth space for possible nuclear tests. NIS-1 capabilities are broad-based and cover the gamut from mission concept to sensor design/manufacture/calibration, as well as spacecraft integration, mission operations, data analysis, and theory. NIS-1 is proud of our international reputation in nuclear phenomenology and proliferation-detection expertise.

NIS-1 is engaged in a mixture of civilian- and defense-related programs supported by DOE, DOD, NASA, and other US government agencies. NIS-1's primary DOE-sponsored mission is to detect and deter clandestine nuclear weapons testing. In support of this mission, NIS-1 develops and operates sensors to detect particle and electromagnetic emissions from nuclear weapons. NIS-1 has also designed, built, and employed sensors that monitor natural and man-made 'backgrounds' in space to study their effects on space systems.


NIS-1 is also engaged in a number of pioneering space missions with our primary civilian customer, NASA, to enhance our underlying expertise in basic research and contribute to our technology base. Those programs cover a number of disciplines, including magnetospheric physics, planetary exploration, lightning physics, and solar-terrestrial interactions.

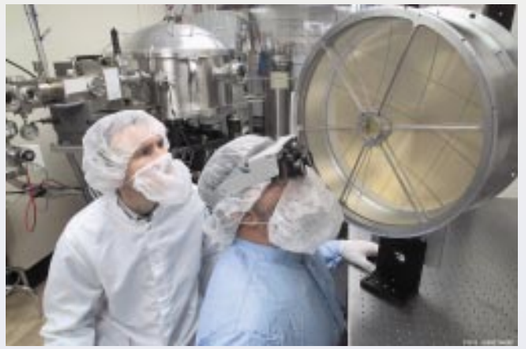
NIS-1's current and near-finished programs, of which we can only list highlights, illustrate the breadth and depth of our activities:

- Neutron, alpha-particle, and gamma-ray spectrometers for NASA's Lunar Prospector mission. These instruments discovered ice on the moon and are helping to write a new chapter in lunar exploration.
- The FORTÉ optical and radio-frequency microsatellite, which has opened new frontiers in lightning research and paved the way to deploying V-sensors for global positioning systems.
- Planetary exploration missions, such as Mars 2001 and the Europa Radar Mapper, which will remotely sense the subsurface composition of those bodies.
- Solar wind missions–including the Ulysses, ACE, and Genesis missions–to collect, analyze, and return samples of solar wind to earth.
- New programs studying electromagnetic signatures from lightning and from anthropogenic activities.
- The IMAGE and TWINS missions, which will provide an entirely new view of the otherwise invisible magnetosphere using neutral-atom imaging.



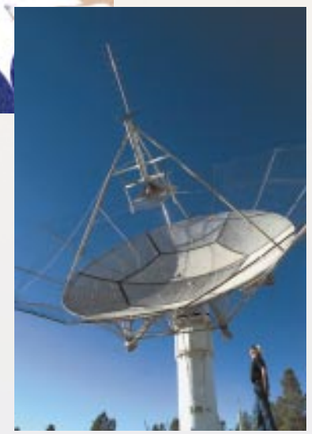
*NIS-1 postdoctoral student prepares a solar wind concentrator for the Genesis mission. This concentrator will collect and return a sample of tenuous solar wind to scientists.*

- New and continuing missions, such as ARII, global positioning systems, and the SABRS mission, to verify limited and comprehensive test ban treaties. The SABRS mission will package five NUDET instruments in one integrated miniature package.
- Numerous additional programs in magneto-spheric physics instrumentation, theory, and modeling, as well as new innovative technology developments that will pave the way into the future.



*NIS-1 scientists inspect the electro-optic telescope that will concentrate solar wind particles for the Genesis mission.*

*NIS-1 Lunar Prospector investigators discuss the location of water-ice discovered on the moon.*



*The Los Alamos Portable Pulser is used to generate and transmit VHF radio-frequency pulses to satellite-borne sensors.*

*NIS-1 researchers test a prototype neutron detector developed to monitor nuclear test ban treaties.*

# Space *and* Remote Sensing Sciences

## NIS–2

**Group Leader:** Paul G. Weber
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**Deputy Group Leader:** Peter C. LaDelfe

The Space and Remote Sensing Sciences (NIS-2) group develops and applies remote sensing instrumentation and analysis to problems of national security and related sciences. NIS-2 applications include nonproliferation, detection of nuclear explosions, space sciences, magnetospheric physics, astrophysics, climatology, and volcanology. We also pursue new ideas in technologies and applications related to our missions.

Our specific capabilities are demonstrated by the following major applications:

- Optical and infrared remote sensing on satellites, aircraft, and on the ground in support of nonproliferation and environmental missions. We concentrate on physics-based end-to-end modeling and analysis, state-of-the-art radiometric calibrations, and innovative new instrumentation. Challenging new applications are in high-resolution spectroscopy for trace gases in the atmosphere and in accurate thermal measurements.
- X-ray, gamma-ray, and energetic particle diagnostics in support of treaty verification and related scientific missions.
- Deployable adaptive processing systems to develop innovative algorithms and prototype demonstration systems for real-time, remote, and autonomous processing of data gathered on land, in air, or in space.
- Astrophysics, including theory, modeling, instrumentation, and data analysis. Our focus is on gamma-ray bursts, x-ray binaries, accretion- and rotation-powered pulsars, neutron star dynamics, atomic processes in astrophysical sources, soft x-ray and extreme ultraviolet (EUV) backgrounds, and soft x-ray and EUV transients such as flare stars. In 1999, we observed the largest-ever known counterpart to a gamma-ray burst with our Robotic Optical Transient Search Experiment collaboration.

*Group members adjust the Robotic Optical Transient Search Experiment which, in 1999, observed the brightest known optical counterpart to a gamma-ray burst.*

- Magnetospheric physics and planetary exploration, including participation in the POLAR and Cluster missions as well as using our own instruments to improve our understanding of the solar/terrestrial system.
- Small-satellite system design, operation, and related data analysis. The ALEXIS satellite, launched in 1993, continues to operate well.

*Earth Watch students learn about astrophysics and examine a telescope under construction.*

- The multispectral thermal imager satellite, developed with Sandia National Laboratories and Savannah River Technology Center, is scheduled for launch in 2000.
- Development of innovative technologies, including the Los Alamos solid-state optical refrigerator, the diamond-based alpha-particle sensor, spatial heterodyne spectroscopy, the remote ultra-low-light imager, and wide-angle imaging lidar.

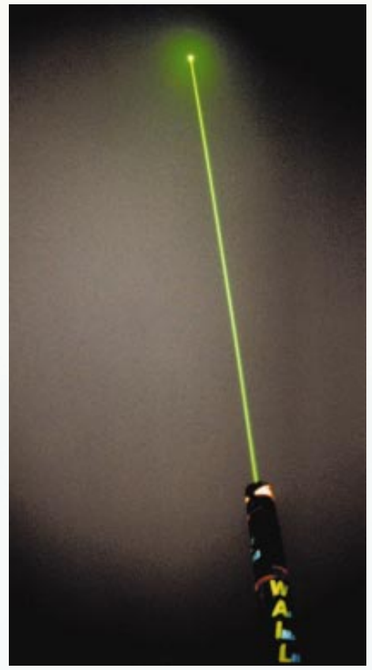
The NIS-2 staff is made up of approximately 70 professionals, including technical staff members, contractors, postdoctoral fellows, guest scientists, and technicians, as well as administrative support personnel. We host a large number of students, both individually and through several Laboratory and external programs.

We have a state-of-the-art optical and infrared calibration facility and significant collaborations with the National Institute of Standards and Technology in this area, including development of new radiometric standards.

Additionally, we have several high-energy, pulsed x-ray sources, vacuum chambers (including thermal vacuum capability), several well-equipped instrumentation laboratories, and extensive computational equipment (workstations, multiprocessor computer clusters, large data storage systems, etc.)

Our major customers are DOE, NASA, and other US government agencies. We also have active collaborations with a number of universities, industry, and other research organizations.

*Wide-angle imaging lidar laser fires at a cloud to measure scattering properties.*



# Space Data Systems

**NIS–3**

**Group Leader:** Stephen G. Blair
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**E-mail:** sblair@lanl.gov
**Acting Deputy Group Leader:** William J. Verzino

The Space Data Systems (NIS-3) group has core capabilities in real-time data acquisition and control, adaptive computing, small-satellite ground stations, scientific and database programming, and system and network administration. NIS-3 group members have a variety of backgrounds, including computer science, computer engineering, and electrical engineering. NIS-3 employees and students work closely with other groups throughout NIS division on joint projects.

Some of our most recent activities include the following:

- Using the new radiation-hardened version of the Power-PC Architecture R-6000 microprocessor in space experiments. This commercial, off-the-shelf processor provides a significant increase in on-orbit capabilities. The NIS-3 focus has been in learning to use the new processor, establishing a software development environment, and writing flight software.
- Developing and testing small, low-cost, application-specific digital cameras using "camera-on-a-chip" and embedded system technologies. Leveraging the recent explosive growth in personal digital camera technology, the programmable, second-generation NTvision cameras exploit scene changes in real-time. An in-camera scene analysis provides immediate and key information in a diverse range of time-sensitive applications, including material inventory verification for nuclear safeguards.

NTvision

*Next generation NTvision "camera-on-a-chip" technology used in low-cost embedded Internet-capable surveillance applications.*

- Designing "adaptive computing" machines based on field-programmable gate array (FPGA) technology. To handle increasingly complex sensors producing larger volumes of data, NIS-3 is using adaptive computing to extract, *in situ*, critical information from sensors. For many signal processing tasks, FPGAs can provide a 100-fold computing performance advantage over traditional microprocessors. Extracting information from data in real time improves control of the sensor, allows for improved observations or extend look time at a region of interest, and helps manage resource requirements for telemetry, analysis, and storage.
- Developing innovative satellite ground stations to communicate with DOE's ALEXIS and FORTÉ small satellites. A major focus of NIS-3 efforts is increasing autonomous satellite operations to reduce the need for operations staff. For the past two years, ALEXIS has demonstrated completely autonomous operations using a ground station at Los Alamos. More recently, in collaboration with the University of Alaska, Fairbanks, a completely autonomous remote ground station for FORTÉ was installed in Fairbanks.
- Applying algorithm development, data handling, and data mining techniques to a wide range of data collected by NIS division projects. We maintain multi-user open and secure computing environments for use in data analysis and visualization, and NIS-3 is responsible for a number of data sets, including satellite data dating from the 1960s.

*The Satellite Operations Center (SOC) at Los Alamos. Satellite operations that once took round-the-clock operator support have been largely automated, significantly reducing operations costs.*

*The Los Alamos satellite ground station antenna at the University of Alaska, Fairbanks. The ground station was recently upgraded with a larger 2.2-meter dish, used to send commands to and receive data from the ALEXIS and FORTÉ spacecraft.*

# Space Instrumentation *and* System Engineering

## NIS-4

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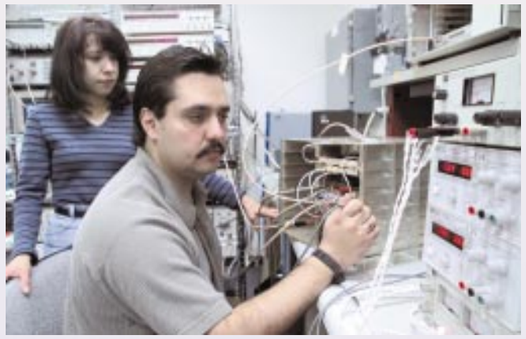
Acting Deputy Group Leader: Donald Mietz

NIS-4 is a science and engineering group that develops custom sensors, instruments, and systems for applications requiring advanced detection, monitoring, or assessment technologies. NIS-4 research and development emphasizes high-quality, reliable instruments with long-lasting lifetimes for operations in high-radiation, low-to-high temperature/pressure, or caustic-fluids environments. In the last 15 years, NIS-4 has successfully developed more than 400 instruments and systems from concept to completion.

NIS-4 capabilities include a broad spectrum of disciplines. An integrated engineering approach allows close interactions between scientists and engineers to achieve our project goals. NIS-4 personnel have experience in optics, solid-state physics, electrical and mechanical engineering, fabrication, assembly, qualification testing, and post-delivery operations.



*Employees of NIS-4 analyze the performance of a V-sensor prototype.*

*NIS-4 employees, designed, fabricated, assembled, tested, and installed the OBCS system, a hyperspectral infrared imaging spectrometer that is used on NASA's WB-57 high-altitude aircraft. The OBCS is used for proliferation detection and is used in the HIRIS project at Lawrence Livermore National Laboratory.*

NIS-4 electrical engineering capabilities include digital design using field-programmable gate arrays (FPGAs); application-specific integrated circuits (ASICS); microprocessor and various glue-logic families; high-speed, low-noise analog circuits; and microminiature mature packaging technologies for optimal speed, noise, and power-consumption performance.

The mechanical engineering staff at NIS-4 develops lightweight and stable structures for applications from deep space to deep within Earth's interior, operating under severe environmental conditions. The design process includes appropriate structural and thermal analyses and tests to validate the integrity and survivability of the system.

Optical engineering expertise includes the design, specification, and layout of optical elements for photonic systems dealing in wavelengths from ultraviolet light through long-wave infrared light, development of system alignment techniques and fixtures, and calibration and alignment instrumentation to verify optical system performance.

*NIS-4 employees assemble a combined x-ray spectrometer and particle dosimeter (CXD) power supply for a global positioning system (GPS).*

A high-speed network of computer-aided design terminals and software supports the group's technical infrastructure. This network efficiently integrates and applies modeling, simulation, analysis, and design during the development process.

Technicians provide support during all phases of instrument and system development, including laboratory testing of concepts and designs, fabrication, assembly, characterizations and calibration, final acceptance testing, and *in situ* operation. Technical capabilities include electronics design, electronics and mechanical fabrication, assembly and testing, environmental coatings, vacuum coatings, and optical assembly, alignment, and characterization testing.

*In collaboration with the Bioscience Division at Los Alamos, NIS-4 is developing small, field-deployable sensor systems for biotoxin detection.*

*Testing of a CXD instrument that will fly on a GPS satellite. GPS satellites are part of the US treaty verification and monitoring system and support the Comprehensive Test Ban Treaty.*

*The high-density interconnect (HDI) multichip module (MCM) was developed as a front-end electronics package to process charge pulses from silicon detectors in a high-energy nuclear physics experiment. Here NIS-4 employees examine data from the HDI MCM.*

*Through the application of Reconfigurable Computing technology, NIS-4 develops advanced signal processing systems to solve complex data analysis problems.*

# Safeguards Science *and* Technology

## NIS–5

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**E-mail:** gavron@lanl.gov
**Deputy Group Leader:** Kenneth L. Alvar

The Safeguards Science and Technology (NIS-5) group works to safeguard nuclear materials by developing techniques and systems for nondestructive assay of nuclear and hazardous material. Applications include nuclear materials control and accountability for domestic DOE nuclear facilities, nuclear waste disposal, material stabilization efforts, and international nonproliferation efforts.

NIS-5 instrumentation and analysis technology measures nuclear materials by detecting and analyzing the neutrons, gamma rays, or heat given off by nuclear material. NIS-5 instrument development begins with conceptual research and physics and proceeds through engineering to an industrial-quality, finished instrument. The analysis can be either active or passive. In active techniques, the nuclear material is bombarded with neutrons or gamma rays, and the neutrons or gamma rays emitted in response are detected. Some nuclear materials produce sufficient quantities of neutrons, gamma rays, or heat to make a detectable passive signature. Analysis of the energies and intensities of these neutrons and gamma rays reveals the identity and quantity of the nuclear materials. A measurement of the total heat output by calorimetry also provides a quantitative measure of the nuclear material

NIS-5 has extensive training program to teach methods of nondestructive assay measurement and analysis and provides more than 30 courses annually presented by experts in the field. NIS-5


*The evolution of neutron-array instruments developed by NIS-5.*

instruments and expertise are used for nuclear waste disposal, safety, and safeguards organizations within the US and throughout the world. The following are some examples of NIS-5 collaborations:

- DOE Office of Safeguards and Security (nondestructive assay technology for nuclear materials accountability and inventory verification in DOE facilities).
- International Atomic Energy Agency (technology development and training).
- International nonproliferation technology (support for US bilateral safeguards collaborations to support the application of inspection technologies).
- Russia and Kazakhstan (materials protection, control, and accountability interactions and training, measurement technology for transparency).
- Waste disposal to the Waste Isolation Pilot Plant (NIS-5 developed equipment used at Rocky Flats).

*Because a shielded HPGe detector weighs 10 Kilograms, high-resolution electroscopy requires two people to operate. Three of Y-12's compact NaI detectors were used interchangably with miniature electronics.*

The following are some of NIS-5's areas of expertise and some specific projects:

- Nondestructive assaying measurement technology using heat, neutrons, and gamma rays (shufflers, passive and active neutron counters, tomographic gamma scanners, and calorimeters).
- Integrated nondestructive assaying systems for control and accountability of nuclear materials.
- Unattended and remote monitoring systems and information management analysis.
- Nondestructive assay training on gamma-ray, neutron, and calorimetry assay, holdup, and waste measurements.
- Detectors and electronics development for portable measurements (miniature electronics modules, CdZnTe gamma-ray detectors, and fast decay-time neutron detectors).

*The SuperHENC, developed by NIS-5, is used to measure the plutonium content of waste generated at Rocky Flats, Colorado.*

- Technology development for holdup, confirmatory measurements, and inventory verification (generalized geometry holdup technique).
- Experimental and computational physics and simulation for nondestructive assaying technology (design of gamma-ray assay systems and neutron multiplicity counters).

*Since 1973 the NIS-5 Safeguards Technology Training program has taught materials accounting and safeguards techniques to hundreds of students, including these from the former Soviet Union.*

# Advanced Nuclear Technology

The Advanced Nuclear Technology (NIS-6) group conducts nuclear criticality research addressing national nuclear issues, trains various national groups in the use of nuclear instrumentation for assay and safe handling, and develops and calibrates nuclear radiation measurement equipment so it can detect and identify minute to sizable quantities of nuclear materials. In this work, NIS-6 uses a large variety of nuclear materials. The group's activities support basic research in nuclear chain-reacting systems and facilitate contributions to arms control and treaty verification, waste assay, safeguards and accountability, and environmental restoration.

NIS-6 also operates the Los Alamos Critical Experiments Facility, a unique facility that contains the largest collection of nuclear critical-mass-assembly machines in the western hemisphere. These assemblies can be broadly categorized as benchmark critical assemblies, general-purpose assemblies, fast-burst assemblies, and solution-critical assemblies. The group uses a variety of nuclear materials that range from small neutron-emitting sources for radiation-detection equipment to larger quantities of uranium and plutonium for criticality experiments.

A key objective for NIS-6 is to teach Laboratory and DOE personnel how to safely handle and manage nuclear materials. NIS-6 staff members conduct classes in criticality safety,

*NIS-6 technical staff represent a national resource for development and verification of instruments used to measure nuclear materials.*

dosimetry techniques, nuclear materials handling methods, and nondestructive assay instrumentation. Another major responsibility is to support the nation's nuclear emergency response capability by training personnel, developing instrumentation, and providing technical expertise.

For nuclear materials safeguards and accountability, waste assay, arms control, and environmental remediation programs, NIS-6 is developing and building a variety of instruments, including the following:

- Pedestrian and vehicle portal monitors.
- Hand-held neutron and gamma-ray detectors.

*Radiation measurement and analysis technology developed by NIS-6 is often transferred to the commercial sector. The hand-held detector shown above is one example of technology that has been successfully transferred to US industry.*

*Members of a trilateral delegation (US, Russia, and the International Atomic Energy Agency) inspect equipment that will be used to verify compliance with international treaties.*

- Enrichment monitors for downblending of highly enriched uranium.
- Combined thermal-epithermal neutron assay systems for radioactive waste in 55-gallon drums and crates.
- Long-range alpha detectors for monitoring personnel, equipment, soils, liquid and gaseous effluents, and radon.
- Attribute verification inspection systems with an information barrier for classified weapons components.

NIS-6 operates a simulation facility that configures nuclear materials to resemble nuclear devices. These mock-ups can be used to develop and validate instruments and methods used in nuclear nonproliferation work. Experimenters measure nuclear warhead components, pits, and triggers in support of initiatives such as START III, the Trilateral Initiative, and International Atomic Energy Agency verifications.

The group's greatest resource is its expert staff with extensive hands-on professional experience in nuclear materials measurement instrumentation. Our staff's ability to communicate technical concepts to both peers and nontechnical colleagues and to share expertise with students contributes to our success. NIS-6 has a strong working relationship with other national laboratories, the DOE, other US government agencies, private industry, and international organizations.

## NIS–6

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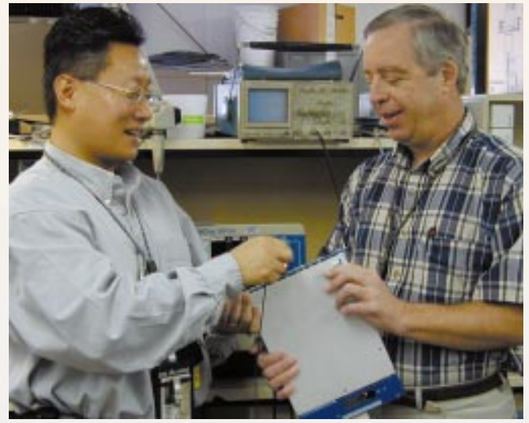
**E-mail:** lussery@lanl.gov
**Acting Deputy Group Leaders:** Nancy Jo Nicholas, Charles A. Goulding



*NIS-6 staff design and develop data acquisition systems for nuclear materials measurements.*


*The Solution High-Energy Burst Assembly (SHEBA) is used for criticality testing of nuclear materials in liquid solutions.*

# Safeguards Systems

It is essential that the United States have the ability to assess current and emerging threats to national security. Focusing on the complex interplay between technology and policy, the Safeguards Systems (NIS-7) group provides important technical support to the US government's threat assessment and mitigation efforts. NIS-7 develops and applies preeminent science and technology in four ways:

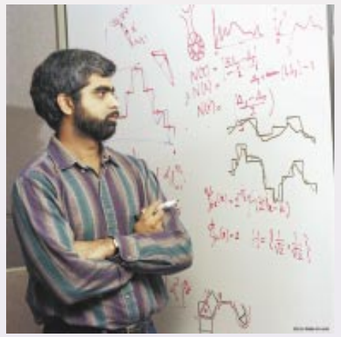
- Identifying and characterizing emerging and persistent threats;
- Assessing and analyzing situations, processes, and data;
- Developing technological solutions and recommended actions; and
- Implementing these solutions and recommendations through direct involvement.

*NIS-7 has fielded prototype activity-monitoring technologies such as this integrated monitoring system, which combines signals from stereo video monitoring with active infrared tags and provides authentication of live signals. This type of technology will support the next generation of arms control treaties.*

This approach is applied to current threat reduction areas of nonproliferation, counterproliferation and counterterrorism, conventional defense, critical infrastructures, and strategic and security issues related to Russia and the former Soviet Union. NIS-7 provides services to customers from the international community as well as to the US government.

Group expertise is applied to the following programmatic areas.

- Improved safeguards for fissile material accountancy and security at DOE sites.
- New approaches for nuclear safeguards under the International Atomic Energy Agency.
- Development of technologies for transparent and irreversible reduction of US and Russian nuclear warheads and fissile material stockpiles.
- Advanced surveillance technologies to detect anomalous activities and situations indicative of security threats.
- Bilateral or multilateral verification of possible cessation of fissile material production.



*Lakshman Prasad of NIS-7 develops new shape-feature extraction algorithms to recognize shapes of objects in moving and still images.*

*NIS-7 scientists develop systems that measure attributes of nuclear materials to determine if they are associated with weapon programs.*

- Materials control and accounting to help secure hundreds of tons of weapons-grade nuclear material in the former Soviet Union.
- Safeguards for disposition of excess US plutonium and highly enriched uranium.
- Verification and transparency of strategic arms reduction.
- Support to the US government on international treaty implementation.

NIS-7 draws on a variety of disciplines, including chemistry, physics, statistics, nuclear engineering, mathematics, computer science, and international relations. In addition to our resident capabilities, we bring together expertise from across Los Alamos to address national security issues.

*Vulnerability assessments quantify the low-safeguards risks associated with glovebox operations at the plutonium facility.*

## NIS–7

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**Deputy Group Leader:** Chad T. Olinger

To accomplish its goals, NIS-7 maintains a broad expertise in nuclear materials process chemistry; facility operations; systems analysis; simulation and modeling; computer-assisted information analysis; software development; destructive and nondestructive measurement methods; as well as national security policy issues pertaining to fissile material management, nuclear weapons reductions, and arms control for weapons of mass destruction. Our broad capabilities enable us to determine how technologies and strategies can counter major national security threats.

*Safeguard studies and methodologies support the Laboratory's processing activities by ensuring the safe and secure storage of nuclear material.*

# Nonproliferation *and* International Technology

## NIS–8

**Group Leader:** Ellen M. Leonard
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**E-mail:** eleonard@lanl.gov
**Deputy Group Leader:** Jim Kowalczyk

The Nonproliferation and International Technology Group (NIS-8) has one of the most diverse work forces in the NIS division. By applying its scientific and engineering skills to designated problems, NIS-8 seeks to deter the proliferation of weapons-usable nuclear materials and the means to produce and use these materials. NIS-8 provides technical support to the export control and intelligence communities, as well as information and analyses of critical technologies related to weapons of mass destruction. We have developed computerized information systems for use within the US government that allow rapid dissemination of accurate information needed for export control and policy decisions. NIS-8 also studies critical technologies that could impact the energy, economic, environmental, or military security of the United States.

NIS-8 expertise includes, but is not limited to, the following:

- Nuclear materials production processes.
- Materials protection, control, and accountability (MPC&A).
- Nuclear weapon design, production, and testing.
- Chemistry and materials science.
- Stockpile surveillance.
- Imagery and multispectral analyses.
- Advanced energy technologies.
- Political science.
- Foreign languages.
- Reactor and fuel cycle design.
- Reactor safety systems evaluation.
- Information and computer science.

NIS-8 plays key roles in performing the following work for DOE and/or the intelligence community.

- Assess MPC&A and other interactions on nuclear-related issues and technologies.
- Evaluate foreign stockpile stewardship/ maintenance programs.
- Analyze foreign nuclear infrastructures.
- Assess key stewardship technologies to support a weapons program.
- Assess weapons-related design and production capabilities.
- Model industrial processes.
- Investigate Comprehensive Test Ban Treaty issues.
- Provide background information and analysis for the Nuclear Cities Initiative.
- Maintain vigilance on advanced alternative energy technologies.

*An imagery analyst works at a light table.*

*NIS-8 personnel review information in the export license processing database.*

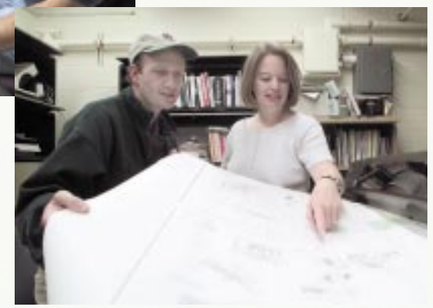
NIS-8 is the lead organization for support on export control issues and activities of the DOE Nuclear Transfer and Supplier Policy Division. It provides the following technical support to the Nuclear Suppliers Group (NSG) and to other national and international nuclear export control organizations.

- Determine those commodities needing control and assist the US government in obtaining national and international agreements for such control.
- Support the US government in export license case reviews.
- Provide training on nuclear technology and proliferation issues for US government export control personnel.
- Develop and maintain the Information Sharing System for the 35-nation NSG.
- Develop, install, and maintain the National Proliferation Information Network System to aid in export license processing and communication between DOE Headquarters, DOE Laboratories, and other agencies concerned with export control and nonproliferation activities.

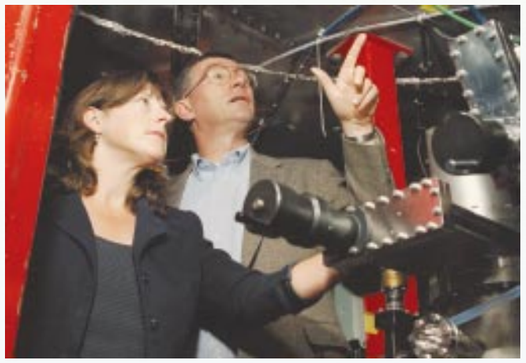
*NIS-8 personnel review equipment for export control.*

NIS-8 maintains a well-mentored and diverse summer student employment program for approximately ten undergraduate students, seven of whom receive partial NIS scholarships. NIS-8 also has provided DOE with trained interns to augment DOE NN-43's mission both in Washington, DC, and abroad.

*Nuclear nonproliferation is enhanced through secure communications among 35 nations.*



*Team members review flow charts for systems analyses.*



# Weapon Design Technologies

**NIS–9**

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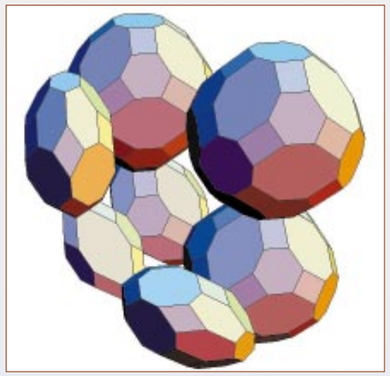
**E-mail:** mwebb@lanl.gov
**Deputy Group Leader:** Thomas Suchocki

The mission of the Weapon Design Technology (NIS-9) group is to study and assess foreign nuclear weapons and to develop technologies for use by the US intelligence community. NIS-9 assesses the technology and capabilities of weapon states, potential nuclear proliferators, and supplier states. The group provides quantitative assessments of foreign nuclear weapons, including materials, yield, packaging, vulnerability, performance, reliability, and testing. Our people and products support a variety of US government entities in the areas of policy advice, treaty verification, and threat assessment. In addition, NIS-9 provides substantial technical support to the nuclear emergency response community.

*This proliferant missile system is capable of delivering a nuclear, chemical, or biological warhead.*

NIS-9 has an effective research and development effort in information operations, radio frequency detection, cryptography, and biotechnology. These efforts can identify significant foreign advancements in state-of-the-art technologies and provide forewarnings of new applications of existing technologies in these areas. In addition, NIS-9 staff, as the DOE's representative, provides expertise to national-level information operations committees. The group is the hub for programmatic and technical coordination of information operations research and development efforts within the Laboratory.

The NIS-9 staff is composed of intelligence professionals that are also technical experts in their field. They are trained in analyzing all-source information to solve practical problems. NIS-9 also draws on the full spectrum of talents available from other Laboratory organizations to provide the breadth and depth of expertise required to analyze issues related to national security objectives for the US intelligence community, DOE, DoD, DOS, FBI, and other government agencies. NIS-9's analyses are a vital component of the government efforts to fully evaluate foreign military and technical capabilities around the world.



*Pictured is a three-dimensional surface patch of a four-dimensional secure communications object, rendered in Mathematica. The object is optimized to maximize bandwidth while preserving a specified security level.*

*A remote RF telemetry monitoring test set-up has been assembled.*

## FMU-74

Facility Management Unit (FMU)-74 is a general purpose facility owned by NIS division, located at Technical Area (TA) 18 and TA-36, that may be used for conducting static and dynamic experiments with fissionable material. The experiments may be conducted at subcritical, critical, or prompt critical. It is the home of the Los Alamos Critical Experiments Facility (LACEF), which has the largest collections of critical assembly machines in the western hemisphere, including both solution and burst machines. The research at this facility forms the general experimental basis for criticality safety practices and provides benchmark data to support nuclear physics computer codes.

## FMU-75

FMU-75 is a multi-user facility composed of TA-33, TA-66, TA-52, several buildings at TA-3, and a defined portion of TA-35. TA-33 is located on State Highway 4, approximately seven miles from White Rock. This is the one of the Laboratory's oldest active sites, dating back to 1947. This area has a history of interesting and varied scientific experimental uses that continue today. TA-33 houses several large buildings that have been renovated to permit open storage of classified material. This is also one of the largest sites at the Laboratory.

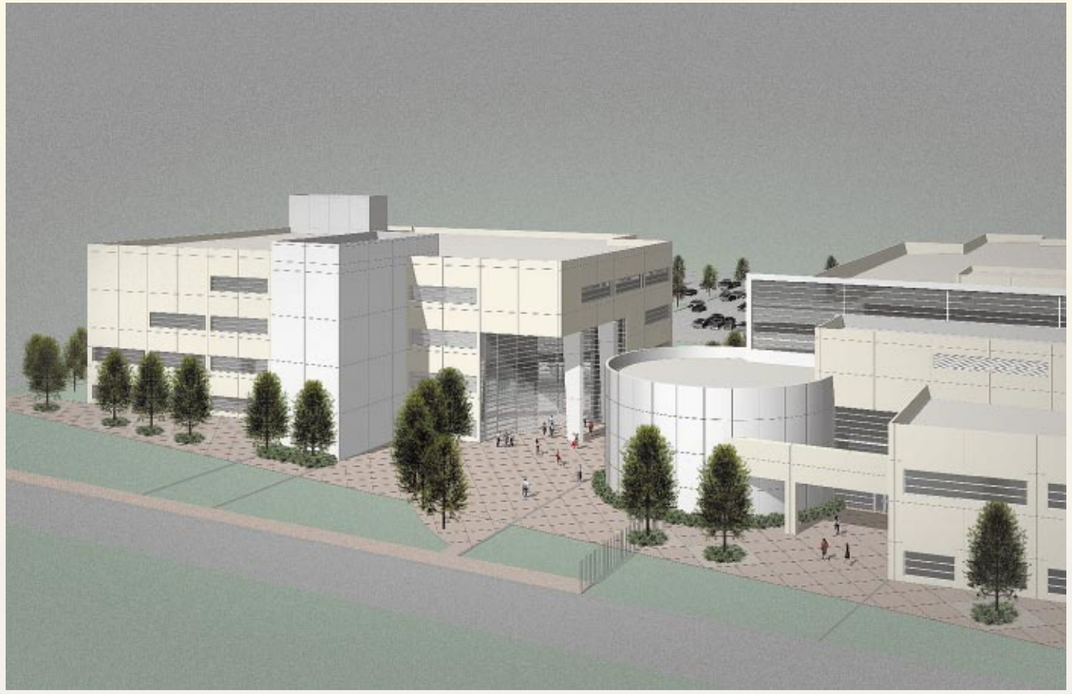
TA-66 is located on Pajarito Road and is one of the Laboratory's newest buildings. This technical area houses the Center for International Security Affairs and the former Soviet Union MPC&A program offices. TA-52 is located off Pajarito Road, east of TA-66. This site houses much of the Technical and Safety Assessment (TSA) division's directorate activities. TA-35 is located on Pecos Drive, approximately one mile northeast of Pajarito Road and 1.5 miles southeast of the intersection of Pajarito Road and Diamond Drive. The FMU-75 portion of TA-35 is not principally occupied by a single division or group like many other technical areas, and it is considered a multi-user facility. FMU-75 also includes several buildings in the TA-3 area, one of which is the Space Science Laboratory.

## TA-18

Los Alamos Critical Experiments Facility (LACEF) operations are centered around three specially designed laboratory buildings, or kivas, that house critical assemblies with remote operation capabilities. In addition, each of the kivas contains its own storage vault where special nuclear materials are stored. An additional laboratory building is available for short-term use of special nuclear materials where "hands-on" measurements may be performed. The facility's special nuclear materials inventory includes a wide variety of material types and forms to meet varying programmatic needs.

The facility also provides laboratories with suitable materials for the development of radiation detectors. Linear accelerators, x-ray generators, and neutron generators may also be used at the facility for detector development and diagnostics. Some past applications of technologies developed within the facility have been in non- and counter-proliferation, safeguards, and treaty verification, as well as in stockpile management and stewardship programs.

NIS Division employs a facility manager and a team of facility management experts to assist tenants with authorization documentation; environment, safety and health issues; quality assurance; and training, facility and waste management.



## COMING IN 2003 . . .

The process to consolidate NIS activities physically and organizationally near the Laboratory's hub has passed initial milestones and is supported by Laboratory and DOE management. Construction of the new facility–the Nonproliferation and International Security Center (NISC)–has begun (in this artists' rendering, NISC is depicted on the left). NISC will enhance program synergy and effectiveness by collocating the NIS nonproliferation, arms control, treaty verification, and intelligence functions near the scientific, technical, and information sources that support these programs.

The new facility will house five of the nine groups, the three program offices, one FMU, and the NIS Division/Program office. Three other groups will be located nearby in existing facilities. Only the Russian Nuclear Program office, because of its large number of foreign visitors, and NIS-6 (and the associated FMU), because of its special critical experiments facility, will remain in their present somewhat remote, locations. The new facility will accommodate over 400 people in spaces designed for technical and administrative offices, light laboratory, light fabrication, special security, and support activities. It will support activities ranging in sensitivity from unclassified operations that may involve foreign nationals through top secret activities.

The facility will be approximately 164,000 square feet, is estimated to cost $60 million, and is expected to open in 2003.

# NIS Lunar Prospector team won 1998 Distinguished Performance Team Award

The NIS Lunar Prospector team won a 1998 Los Alamos Distinguished Performance Team Award in recognition of its accomplishments with NASA's Lunar Prospector satellite. The NIS Lunar Prospector team accomplished the complete scientific effort from experiment concept to publication of results, capturing the public spotlight for their discovery of water on the moon.

The Lunar Prospector mission is one of NASA's Discovery series of missions and the first to be competitively selected. To be selected, the NIS Lunar Prospector team set some very ambitious goals to achieve with a very small budget in a very short time. The Lunar Prospector was developed and built in just 22 months for just over $63 million dollars, including spacecraft, instruments, launch vehicle, and one year of operations.

The NIS team built three of the five instruments on board Lunar Prospector—the neutron, gamma-ray, and alpha-particle spectrometers. While most space-qualified sensors take years to prepare, the NIS Lunar Prospector team took three completely different flight spectrometers from a paper design to completion in only 14 months after receiving the go-ahead. These spectrometers met all specifications and were completed on schedule and within budget. This remarkable achievement required engineering, technical, and management activities at a level virtually unheard of in the space field.

On March 5, 1998, the NIS Lunar Prospector team captured the public's imagination by announcing the discovery of a definitive signal of water ice at both lunar poles. The report of the discovery of water ice at both poles was covered internationally in many newspapers, radio and television broadcasts, and science magazines. The discovery received a "Best of What's New" award from *Popular Science* magazine.

# 1997 Distinguished Performance Team Award won by NIS FORTÉ team

The FORTÉ satellite was launched on August 29, 1997, to measure radio emissions from lightning, to support the Laboratory's mission of nuclear test monitoring, and to advance microsatellite technologies. Since it's launch, FORTÉ has exceeded its mission and continues to return a rich harvest of programmatic and scientific results.

FORTÉ was born out of Los Alamos's heritage in monitoring for electromagnetic pulses (EMP) from illegal atmospheric nuclear tests. Los Alamos has been operating the so-called W-sensor that monitors for EMP on the global positioning system satellites. FORTÉ allowed scientists to understand more about the backgrounds produced by natural and man-made radio signals that allowed them to develop the much more capable V-sensor, which will replace the W-sensor on the next generation of global positioning system satellites.

The most common backgrounds in the W-sensor and V-sensor measurements come from lightning, and FORTÉ carries both a radio-frequency receiver and an optical lightning system (comprising a CCD imager and a fast broadband photometer) that are ideally suited to study lightning from space. The FORTÉ team has collected measurements of literally millions of lightning discharges. They have also conducted campaigns with the National Lightning Detection Network, with Kennedy Space Center's Lightning Detection and Ranging system, and with the New Mexico Institute of Mining and Technology's Lightning Mapping System. They have also deployed their own Lightning-Detection Array, which comprises 11 stations in the United States. Each of these joint observations has led to new insights on the observation of lightning from space.

Using FORTÉ data, the team has developed new theories of lightning generation and propagation and are working to determine the feasibility of a global thunderstorm-monitoring mission using the V-sensor that will eventually be deployed on all 24 global positioning system satellites. This secondary "green mission" could provide enormously useful, continuous, global, real-time monitoring of electrical activity in Earth's atmosphere.

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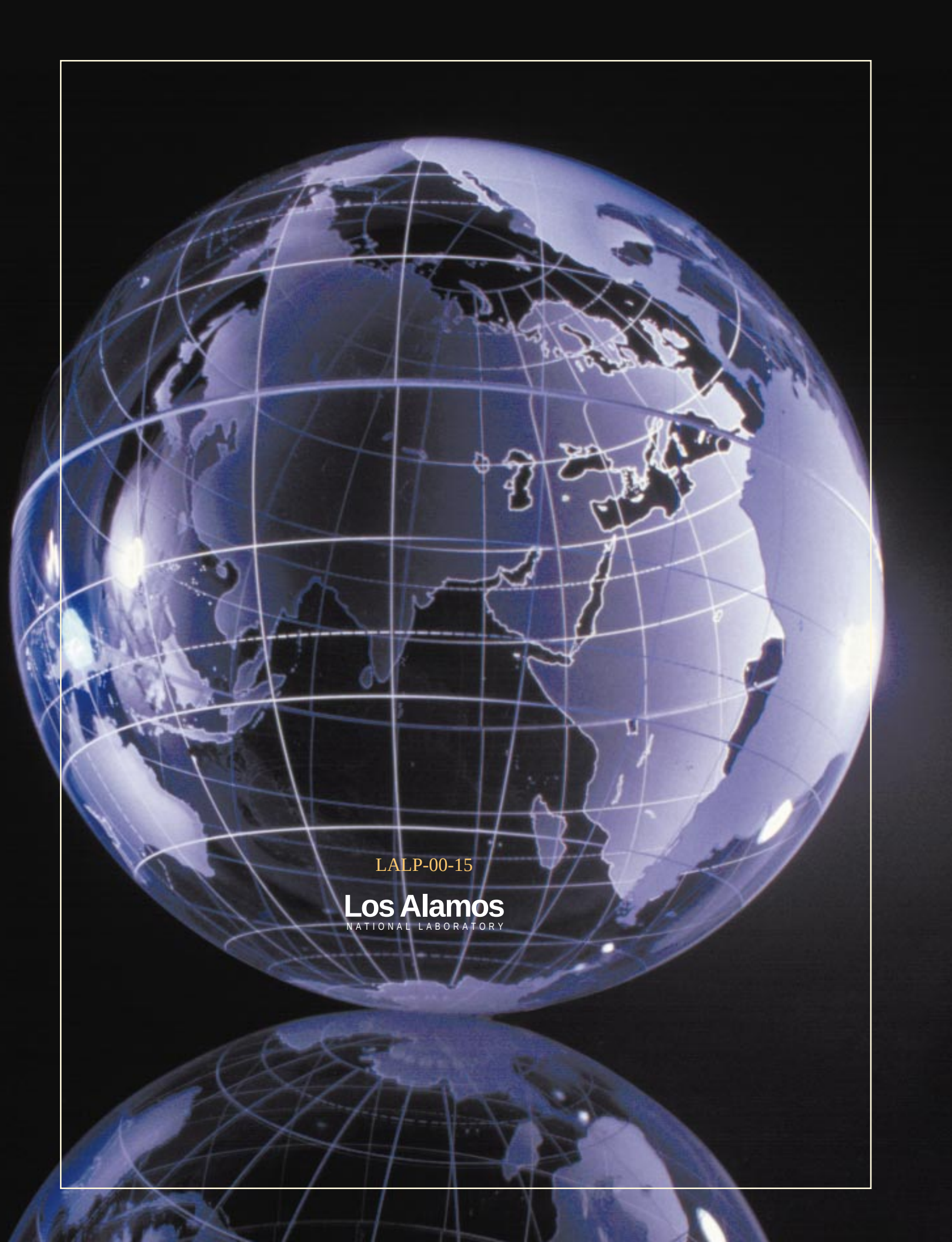
**Additional information on NIS Division is available at: http://www.lanl.gov/orgs/nis**



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